KS-16575-L1 AMPLIFIER (McINTOSH)
DESCRIPTION

CONTENTS

		PAGE
1.	GENERAL	1
2.	ELECTRICAL CHARACTERISTICS	1
3.	CIRCUIT FEATURES	3
4.	INSTALLATION	6
5.	PARTS LIST	6

1. GENERAL

1.01 This section describes the KS-16575-L1 amplifier. The electrical and mechanical features of this amplifier are discussed in detail; installation information is also included.

1.02 This amplifier was designed as a general purpose program amplifier. Its principal application is in audio program transmission. It can also be used for data and facsimile transmission and for monitoring, supplying audio power to loudspeakers or other equipment. The amplifier may be used on subscriber premises.

1.03 The amplifier contains its own power supply which requires 110 to 130 volts ac (nominally 117V or 125V) 50 to 60 cycles. Assuming proper power line voltage, the power consumption is approximately 100 watts. A power cord is not provided with the amplifier. The amplifier is protected by a 2-ampere fuse.

1.04 The KS-16575-L1 amplifier may be mounted in a 19-inch relay rack or cabinet. The amplifier is 19 inches wide, 7 inches deep (behind the mounting surface) and 7 inches high. The amplifier is shown in Figs. 1 and 2. On the front side of the chassis and extending through the cover panel are an "ON-OFF" power switch, a pilot light, the gain controls and fuse holder. The amplifier weighs 33 pounds. The amplifier is finished in light gray.

1.05 The mechanical and electrical characteristics shown are those for a typical amplifier. They do not necessarily indicate manufacturing or performance limits.

2. ELECTRICAL CHARACTERISTICS

2.01 The nominal electrical characteristics of the amplifier are as shown in Table 1. Typical performance characteristics are shown in Fig. 3. The "maximum program level output" listed in Table 1 is given to show the maximum permissible level at this point as would be indicated by measurement with a standard volume indicator.

Fig. 1 – Front View

Fig. 2 – Rear View

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2.02 The input and output transformers are sufficiently well balanced and shielded to permit their direct connection to exchange or toll cable and open wire circuits. The usual central office or station protection should be provided, however.

2.03 The range of impedances from which the amplifier input can operate is given in Table 2. The range of output impedances is shown in Table 3. Over the ranges shown, the amplifier can deliver 10 watts of single frequency power with no more than 0.5% distortion to a load connected to the 2-, 8-, 16- or 600-ohm (low impedance) windings. Up to 3.2 watts power can be taken from the output connection which provides a 600-ohm internal output impedance; if greater power is taken from this output circuit, the ratings of some elements of the output tubes will be exceeded. If load impedance values which are lower than those listed are connected to the amplifier the power output capability will be reduced and the signal distortion will increase. The internal output impedances are about 1/10 the nominal values.

Table 1

	"600-OHM" OUTPUTS INTERNAL OUTPUT IMPEDANCE		LOW IMPEDANCE OUTPUTS		
	600-OHM	60-OHM	2-OHM	8-OHM	16-OHM
Maximum single frequency power output for less than 0.5% harmonic distortion	3.2 watts (+35 dbm)	10 watts (+40 dbm)	10 watts	10 watts	10 watts
Maximum program level output	+25 vu	+30 vu	+5 vu	+11 vu	+14 vu
Maximum gain, 600-ohm input*	58 db	63 db	38 db	44 db	47 db
Maximum gain, bridging input*	34 db	39 db	14 db	20 db	23 db

*Measured between 600-ohm measuring sets.

	COMMON TO ALL OUTPUTS
Frequency response referred to 1,000-cycle response	±0.25 db, 50 to 15,000 cycles ±0.5 db, 20 to 20,000 cycles
Input impedances	150 ohms, 600 and 10,000 ohms balanced
Gain control range	44.5 db in 0.5 db steps; an "off" position is available
Ratio of max. single frequency output signal to unweighted noise	90 db or greater
Maximum input level	+10 dbm (0 vu)

Table 2

NOMINAL INPUT IMPEDANCE	INPUT IMPEDANCE RANGE	INTERNAL INPUT IMPEDANCE	INPUT TERMINALS
600 ohms	300 to 1,200 ohms	600 ohms	3-4
600 ohms bridging	Zero to 10,000 ohms	10,000 ohms	1-2
150 ohms	75 to 300 ohms	150 ohms	3-5

Table 3

NOMINAL OUTPUT IMPEDANCE	LOAD IMPEDANCE RANGE	INTERNAL OUTPUT IMPEDANCE	OUTPUT TERMINALS
2 ohms	1 to 5 ohms	0.4	15-16
8 ohms	5 to 12 ohms	0.8	14-16
16 ohms	12 to 48 ohms	1.2	13-16
Low imp. 600 ohms	300 to 1,200 ohms	58	10-12
Matching 600 ohms	500 to 700 ohms	600	8-9

Note: All output windings may be operated with one side grounded, if required.

3. CIRCUIT FEATURES

3.01 The KS-16575-L1 amplifier is designed to meet program transmission requirements. The amplifier consists of an input transformer, gain controls, voltage and power amplifying stages and an output transformer. The amplifier contains an ac operated heater and plate power supply. An over-all negative feedback loop is used around the amplifying stages and the output transformer. A schematic diagram of the amplifier circuit is shown in Fig. 4, Page 9.

3.02 The input transformer (T1) is arranged to match 150-ohm and 600-ohm lines or to bridge a 600-ohm line. Resistors are used to build up the input impedance to 10,000 ohms for the bridging input. The input transformer is loaded by resistors both on its primary and secondary to provide flat frequency response and an input impedance of 600 ohms.

3.03 Two gain controls follow the input transformer. These are arranged in potentiometer fashion and are designed to present a substantially constant load on the input transformer. The first control following the input transformer has 9 steps of 0.5 db, allowing 0 to 4.5 db of attenuation; the second attenuator has 8 steps of 5 db each. The last step has infinite loss; thus the control provides 0 to 40 db of attenuation plus an "off" position.

3.04 A voltage amplifying stage follows the gain control, using one-half (V_1A) of a 12AX7 electron tube. The other half of this tube is unused. This 12AX7 is directly coupled to a 12AU7 cathode coupled phase inverter (V_2A and B). The 12AU7 is RC coupled to a 12BH7 push-pull voltage amplifier (V_3A and B). This 12BH7 is RC coupled to the grids of the 6L6GB output tubes, V_4 and V_5. The plate load resistors for the 12BH7 and the grid resistors of the 6L6GB tubes are connected to primary windings of the output transformer to provide a feedback arrangement which allows the 12BH7 to develop considerable drive voltage for the 6L6GB tubes at low distortion. The 6L6GB tubes operate using a unity coupled circuit which in effect loads the output tubes in both their cathode circuits (as partial cathode followers) and in their plate circuits (as partial plate loaded). This arrangement allows the use of local negative feedback in the output stage. The output transformer has two primary windings with unity turns ratio between these windings. One winding is used for the cathodes of the 6L6GB tubes and the other winding is used for the plates. The screen grids of the 6L6GB tubes are connected in an arrangement which allows these tubes to function as tetrodes.

3.05 The output transformer, T2, is provided with the above-mentioned primary windings plus three (3) sets of secondary windings. The first secondary winding is used to provide voltage for a negative feedback loop which includes all of the amplifying stages plus the output transformer. The negative feedback voltage is applied to the cathode of the 12AX7 tube through a suitable voltage divider arrangement. About 20 db of feedback is used.

3.06 A second secondary winding provides outputs for loads having nominal impedances of 2, 8, or 16 ohms. A third secondary winding provides an output for 600-ohm loads. This 600-ohm secondary feeds two resistor assemblies which are connected to a second set of output terminals. The internal output impedance of this output circuit as seen through the resistor as-

sembly is 600 ohms. The internal output impedance of the 600-ohm output winding alone is about 60 ohms. This is indicated in Table 3, above.

3.07 The power supply uses a conventional power transformer and full wave rectifier followed by a choke input filter. The choke (T3B) is sealed in a common case with the power transformer (T3A). The second and third sections of the high voltage filter involve R and C sections. AC is used to supply all electron tube heaters. A hum balance potentiometer is used in the common heater supply circuit to help improve the signal-to-noise ratio.

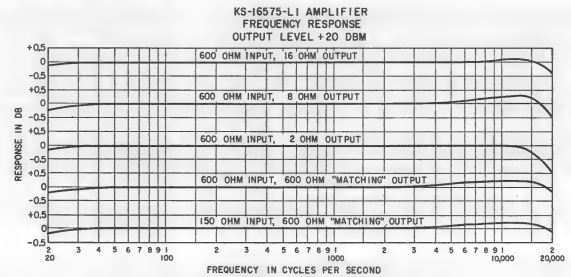

Fig. 3A – Amplifier Frequency Response

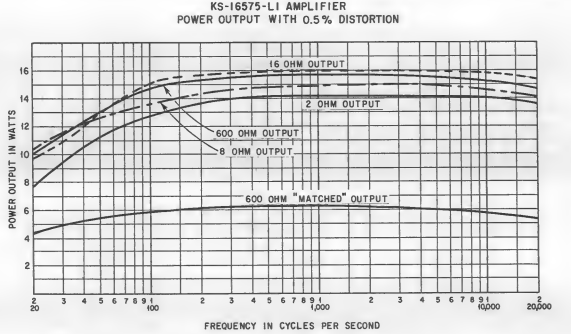

Fig. 3B – Amplifier Distortion Characteristics

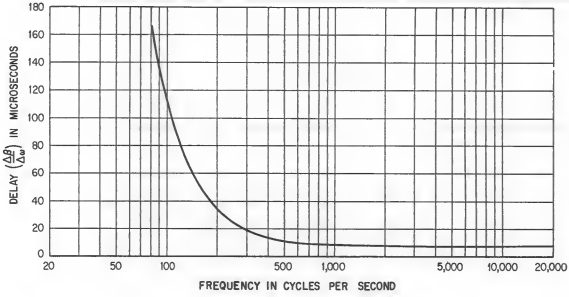

Fig. 3C – Envelope Delay Distortion

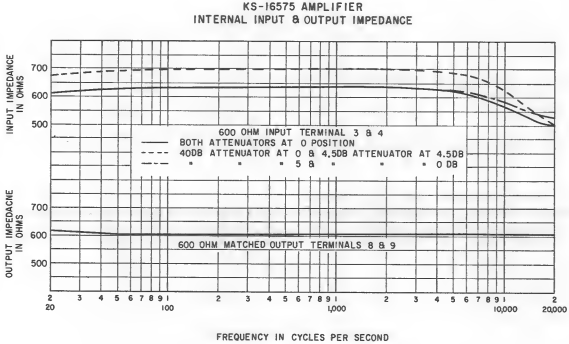

Fig. 3D – Internal Amplifier Impedances

4. INSTALLATION

Mounting and AC Supply

4.01 In general, the KS-16575-L1 amplifier will operate satisfactorily at normal ambient room temperatures. Continuous operation in locations of high ambient temperature (over 100°F) is not recommended. Several KS-16575-L1 amplifiers may be mounted in a relay rack or equipment cabinet without forced ventilation provided 100°F room temperature is not exceeded. At least 100 square inches of open area should be provided both above the top amplifier and below the bottom amplifier in an enclosed cabinet. The recommended minimum spacing between cabinet-mounted amplifiers (electron tubes horizontal) is given in Table 4.

Table 4

NUMBER OF AMPLIFIERS	RECOMMENDED SPACING
3	1-3/4″
4	3-1/2″
5 to 8	5-1/4″

4.02 The ac supply can be brought into the amplifier either through conduit or by means of a flexible appliance cord. The neutral conductor should be connected to either terminal 18 or 19. The ungrounded conductor should be connected to terminal 20. Power conductors should enter the amplifier from the right side as it is viewed from the front or cover mat side.

4.03 The amplifier output circuit should enter the right side of the amplifier. The input circuit should enter the amplifier chassis from the opposite (left) side. For "bridging" input use terminals 1 and 2; for 600-ohm input use terminals 3 and 4; for 150-ohm input use terminals 3 and 5.

4.04 The amplifier should be mounted so that the electron tubes are toward what is normally the "wiring" side of the frame. The cover mat and external controls will then be on the "apparatus" side of the frame.

4.05 For some applications the minimum gain of the amplifier (about 14 db) will be greater than that required for proper circuit operation. Where this is the case, an external input pad can be provided or, as an alternative, the loss of the "bridging" input can be utilized. Where this is to be done, the incoming circuit should be connected to terminals 1 and 2; in addition a 600-ohm resistor (106A or 146A) should also be connected to these terminals as a circuit termination. This will provide about 25 db loss at the amplifier input, resulting in a minimum amplifier gain equivalent to about 11 db loss between 600-ohm impedances.

4.06 Where the amplifier is used to feed a single outgoing circuit or equipment requiring a 600-ohm source impedance, the amplifier output circuit providing a 600-ohm internal output impedance (terminals 8 and 9) should be used. This is also referred to as a "600-ohm matching" output. Where several output lines are to be connected through a bridge arrangement, having an internal input impedance of not less than 300 ohms, then the connection should be made to terminals 10 and 12, which have a low internal output impedance. Where the internal input impedance of the bridge arrangement is less than 300 ohms but more than 12 ohms, as is the case with the "G-type" bridges, connection should be made to the 16-ohm output circuit.

Grounding of Shielded Wire

4.07 A good C. O. or building ground should be connected to the amplifier circuit ground (terminal 6 or 17). Amplifier circuit ground is insulated from the amplifier chassis but the two are usually connected together by means of a strap between terminals 6 and 7. This strap is supplied at the factory and should remain in place unless transmission tests indicate that better noise performance will result if the amplifier circuit ground is disconnected from the chassis of a relay rack-mounted amplifier.

4.08 All wiring shields should be electrically continuous and grounded only at the amplifier.

4.09 In central office installations, type BF shielded wire or equivalent may be used for wiring the input and 600-ohm output circuits. Type SK wire may be used on customer premises.

5. PARTS LIST

5.01 The various component parts of the KS-16575-L1 amplifier are listed in Table 5. A diagram showing the location of the various component parts is shown in Fig. 5.

Table 5

Parts List for KS-16575-L1 Amplifier

DESIGNATION	RATING	MANUFACTURER
CONDENSERS		
C1	100 MFD, 12V, Electrolytic	Cornell Dubilier, Type BBR
C2	Not Used	
C3	12 MFD, 250V, Electrolytic	Cornell Dubilier, Type BBR
C4	.25 MFD, 600V, Mylar	Goodall, Type 620
C5	.022 MFD, 10%, 400V, Paper	Sprague, Type 109P
C6	.022 MFD, 10%, 400V, Paper	Sprague, Type 109P
C7	.25 MFD, 600V, Mylar	Goodall, Type 620
C8	.25 MFD, 600V, Mylar	Goodall, Type 620
C9	25 MFD, 25V, Electrolytic	Cornell Dubilier, Type BBR
C10	25 MFD, 25V, Electrolytic	Cornell Dubilier, Type BBR
C11	.001 MFD, 500V, Ceramic	Erie, Type GP2L
C12	40-40-20- MFD, 450V, Electrolytic	Sprague, Type 17D
RESISTORS		
R1	4.7K, 5%, 1/2W	Allen Bradley, Type EB
R2	4.7K, 5%, 1/2W	" " "
R3	1.5K, 5%, 1/2W	" " "
R4	68K, 10%, 1/2W	" " "
R5A	100K, 5%, 1/2W	" " "
R5B	4.3K, 5%, 1/2W	" " "
R5C	3.9K, 5%, 1/2W	" " "
R5D	3.9K, 5%, 1/2W	" " "
R5E	3.9K, 5%, 1/2W	" " "
R5F	3.9K, 5%, 1/2W	" " "
R5G	3.6K, 5%, 1/2W	" " "
R5H	3.6K, 5%, 1/2W	" " "
R5J	3.6K, 5%, 1/2W	" " "
R5L	3.6K, 5%, 1/2W	" " "
R6A	1K, 5%, 1/2W	" " "
R6B	750, 5%, 1/2W	" " "
R6C	1.3K, 5%, 1/2W	" " "
R6D	2.4K, 5%, 1/2W	" " "
R6E	4.3K, 5%, 1/2W	" " "
R6F	7.5K, 5%, 1/2W	" " "
R6G	13K, 5%, 1/2W	" " "
R6H	24K, 5%, 1/2W	" " "
R6J	43K, 5%, 1/2W	" " "
R7	3.3K, 10%, 1/2W	" " "
R8	68, 5%, 1/2W	" " "
R9	680K, 10%, 1/2W	" " "
R10	100K, 10%, 1/2W	" " "
R11	330K, 10%, 1/2W	" " "
R12	2.2M, 10%, 1/2W	" " "
R13	18K, 10%, 1W	" " Type GB
R14	27K, 5%, 1/2W	" " Type EB

Table 5 (Contd)

DESIGNATION	RATING	MANUFACTURER
RESISTORS		
R15	30K, 5%, 1/2W	Allen Bradley, Type EB
R16	220K, 10%, 1/2W	" " "
R17	220K, 10%, 1/2W	" " "
R18	1.2K, 10%, 1/2W	" " "
R19	12K, 10%, 2W) Matched	" " Type HB
R20	12K, 10%, 2W) to 1%	" " Type HB
R21	560K, 10%, 1/2W	" " Type EB
R22	560K, 10%, 1/2W	" " "
R23	220, 10%, 2W	" " Type HB
R24	220, 10%, 2W	" " "
R25	560, 5%, 2W	" " "
R26	510, 5%, 2W	" " "
R27	560, 5%, 2W	" " "
R28	510, 5%, 2W	" " "
R29	1.3K, 5%, 1/2W	" " Type EB
R30	250, 1/2W, Potentiometer	Chicago Telephone, Type 45
R31	150, 10%, 10W	I.R.C., Type PW-10
R32	10K, 10%, 1W	Allen Bradley, Type GB
R33	10K, 10%, 1/2W	Allen Bradley, Type EB
ELECTRON TUBES		
V1	12AX7	
V2	12AU7 (or 12AU7A)	
V3	12BH7 (or 12BH7A)	
V4	6L6GB (or 6L6G-GA)	
V5	6L6GB (or 6L6G-GA)	
V6	5U4GB (or 5U4GA)	
MISCELLANEOUS		
F1	Fuse, 2A, Type 3AG	Littelfuse #312002
L1	R.F. Choke, 1.5 micro H.	I.R.C., Type CLA
L2	R.F. Choke, 2.7 micro H.	I.R.C., Type CLA
P1	Pilot Lamp, #1847	
S1	Rotary Switch, SP-10-T	McIntosh Part A-125-SW1-2
S2	Rotary Switch, SP-10-T	" " " "
S3	Toggle Switch, SPST	Arrow, Hart & Hegeman, #82601
T1	Input Transformer	McIntosh Part M-174
T2	Output Transformer	McIntosh Part M-195
T3A & B	Power Transformer and Choke	McIntosh Part M-196

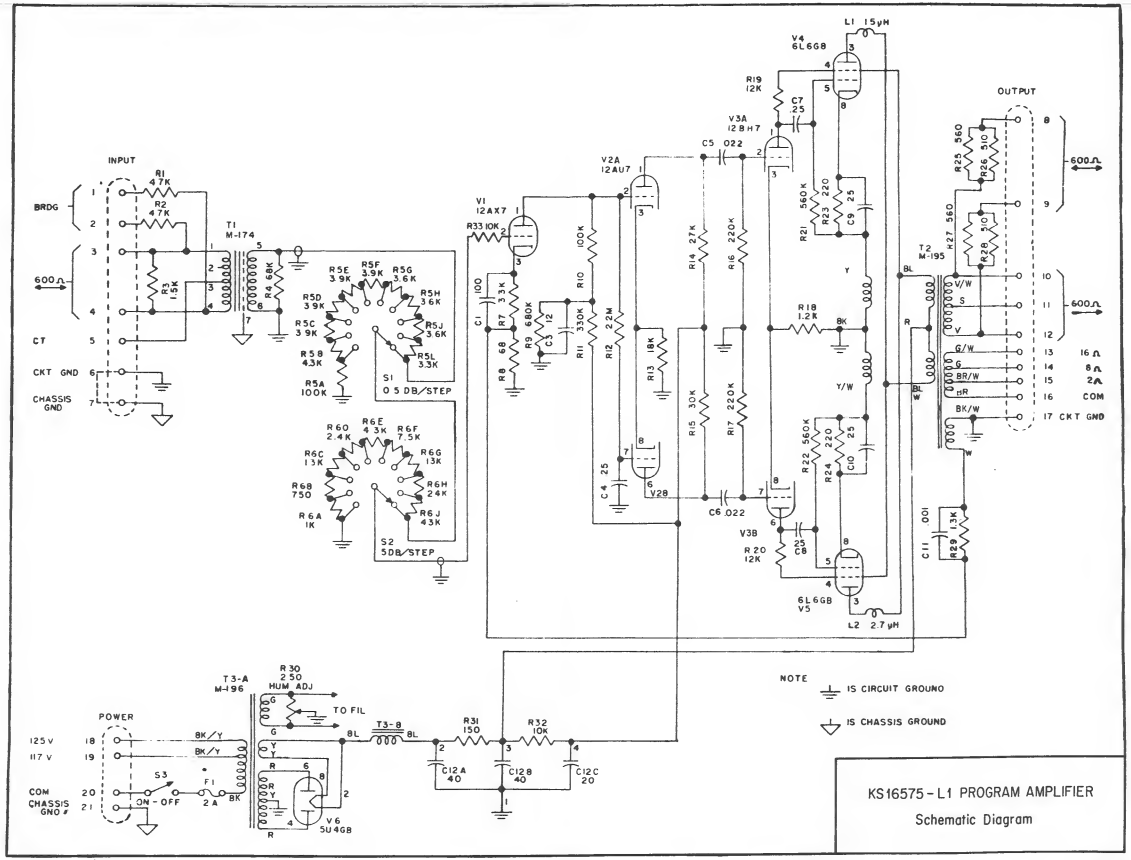
INPUT
BRDG
600Ω
CT
CKT GND
CHASSIS GND
R1 47K
R2 47K
R3 1K
T1 M-174
R4 68K
R5A 100K
R5B 43K
R5C 3.9K
R5D 3.9K
R5E 3.9K
R5F 3.9K
R5G 3.6K
R5H 3.6K
R5J 3.6K
R5L 3.3K
S1 0.5 DB/STEP
R6A 1K
R6B 750
R6C 1.5K
R6D 2.4K
R6E 4.3K
R6F 7.5K
R6G 13K
R6H 24K
R6J 43K
S2 5DB/STEP
V1 12AX7
R33 10K
C1 100
R7 3.3K
R8 68
R9 680K
C3 12
R10 100K
R11 330K
R12 2.2M
R13 18K
C4 25
V2A 12AU7
V2B
C5 .022
C6 .022
R14 27K
R15 30K
R16 220K
R17 220K
V3A 12BH7
V3B
R19 12K
R20 12K
C7 25
C8 25
R21 560K
R22 560K
R23 220
R24 220
C9 25
C10 25
V4 6L6GB
V5 6L6GB
L1 15μH
L2 2.7μH
R18 1.2K
C11 .001
R29 1.3K
OUTPUT
R25 560
R26 510
R27 560
R28 510
T2 M-195
600Ω
16Ω
8Ω
2Ω
COM
CKT GND
V/W
G/W
BR/W
BK/W
Y/W
T3-A M-196
R30 250 HUM ADJ
TO FIL
T3-B
R31 150
R32 10K
C12A 40
C12B 40
C12C 20
POWER
125 V
117 V
COM
CHASSIS GND
S3 ON-OFF
F1 2A
V6 5U4GB
NOTE
IS CIRCUIT GROUND
IS CHASSIS GROUND
KS16575-L1 PROGRAM AMPLIFIER
Schematic Diagram

Fig. 4

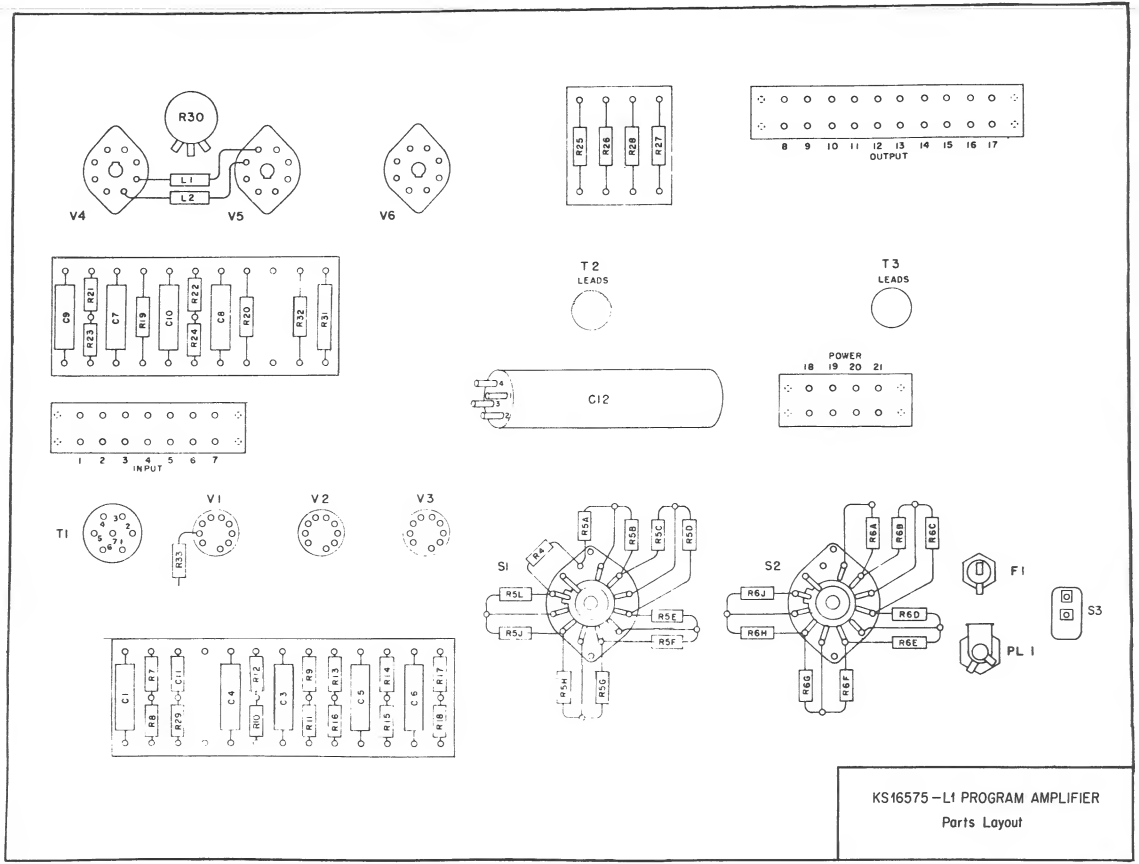
R30
L1
L2
V4
V5
V6
R25
R26
R28
R27
8 9 10 11 12 13 14 15 16 17
OUTPUT
C9
R21
R23
C7
R19
C10
R22
R24
C8
R20
R32
R31
T2
LEADS
T3
LEADS
C12
POWER
18 19 20 21
1 2 3 4 5 6 7
INPUT
T1
V1
V2
V3
R33
S1
R5A
R5B
R5C
R5D
R4
R5L
R5E
R5J
R5F
R5M
R5G
S2
R6A
R6B
R6C
R6J
R6D
R6H
R6E
R6G
R6F
F1
PL 1
S3
C11
R8
R7
R29
C11
C4
R12
R10
C3
R9
R11
R13
R16
C5
R14
R15
C6
R17
R18
KS16575 – L1 PROGRAM AMPLIFIER
Parts Layout

Fig. 5